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28 July 1992

Mr. Cristopher Anderson
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L.E. Carpenter and Company
1301 E. Ninth Street
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Cleveland, OH 44114-1824

W.O. No.: 3600-06-37

RE: Roy F. Weston Comments on Treatability Study

Dear Cris:

Enclosed you will find our comments and recommendations regarding the Treatability Study completed by IT. WESTON suggest that these comments be considered prior to initiating a revision to the draft report. It is also advisable to await NJDEPE comments prior to revising the document.

If you have any questions or comments regarding this review, please do not hesitate to call me at (908) 225-3990.

Very truly yours,

ROY F. WESTON, INC.

Martin J. O'Neill
Project Manager



**BIOREMEDIATION AND SOIL FLUSHING
TREATABILITY STUDY REPORT
L.E. CARPENTER AND CO.
PART 1 OF 2
JUNE 1992**

These comments are provided based upon the review of the Bioremediation and Soil Flushing Treatability Study Report, L.E. Carpenter and Co., Part 1 of 2, June 1992. This review did not include verification that these Treatability Studies as implemented complied in all respects with the scope of work and/or Test Plan. In addition, Volume 2 of 2, the data appendix, was not reviewed. The following specific comments are offered:

Section	Page	Paragraph	Comments
3.1	3-1	4th & 5th bullets	The recommended nutrient levels appear high. Please provide the rationale for this recommendation. If this high dosage is needed to satisfy nutrient adsorption by soils (as suggested in bullet 5) and if subsequent nutrient addition require lower levels of nutrients, it should be so indicated.
3.4	3-3	1	In developing recommendations for the use of surfactant flushing of soils, some consideration should be given to the relatively high level of surfactant which would be required based upon the data from this treatability study and whether low concentrations of surfactants could be used in field application. Surfactant levels as used in the laboratory treatability study may be impractical for field application.
4.1	4-1	1	The text states that these treatability studies should be considered remedy screening tests (as would be appropriate in this point of the feasibility study). The fact that these are remedy screening studies and the limitations inherent in remedy screening studies should be noted both in this report and in the Feasibility Study. As acknowledged in EPA guidance, additional remedy selection or remedial design studies may be necessary.
4.3	4-2	1	Please indicate whether analytical controls for adsorption of contaminants on laboratory vessels and glassware were considered necessary.

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4.3.2.2	4-3	2	Please indicate how the determination was made that the solution flowed directly to the sample with minimal movement along the sample confining wall interface as stated in the third to last line. In the subsequent paragraph, please indicate why the up flow mode of operation resulted in a "nearly" saturated (rather than completely saturated) sample through the course of flushing study. In the final paragraph in this section (on the top of page 4-4), there is an incomplete sentence in line 4 beginning with "This feature continuous...."
4.4.1	4-4	1	The text states that representative samples of each soil were analyzed for an initial estimate of contaminant concentration. As discussed in later sections of the document, this sample was, in fact, taken from an area adjacent to the soil core used for testing to avoid disturbing that soil core. For this reason, the initial concentration of contaminants based upon this sample could not be used to evaluate overall removal efficiency in the soil column. Therefore, to avoid confusion, this paragraph should indicate that the sample was considered representative of the overall soil column but not necessarily of that portion of the soil column used for testing.
4.4.3	4-5		For completeness, this section should tabulate analytical methods used for soils as well as for groundwater (which are presented in Section 4.4.3.1).
4.4.3.2	4-7	1	Editorially, this and subsequent subsections should be revised to reflect what was done rather than what "will" be done. Some of this section reads more like the Test Plan than the Test Report. With respect to the microbial inhibition testing, please indicate the relative sensitivity of the tests, that is, the relatively sensitivity of the cells density measurement and what degree of change is required to draw presumptive conclusions regarding inhibitions. This information is subsequently presented in the results section (5.1.2.9), but for clarity, it is also recommended that the limitations be stated here as well.
4.4.3.3	4-7	2	Please clarify which sampling points were chosen based upon microbial activity.

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4.4.3.3	4-7	3 line 5	Recommend changing "activated municipal sludge" to "municipal activated sludge." In addition, please describe the washing program that was used to deplete residual dissolved carbon from the activated sludge sample. The sentence referring to the washing program refers to sludge amended test treatments. The next sentence deals with the soil amended treatments. The final sentence deals again with sludge amended treatments. For clarity, it is recommended that the discussion of sludge treatment vs. soil treatment be kept separate.
4.4.3.3	4-7 & 4-8	4	Please indicate why test water was removed from the <u>bottom</u> of the composite sample container. In the following paragraph on page 4-8, please indicate how vessels were sampled.
4.4.3.4	4-8	1	Microbial Enumeration Testing. The text states that the impact of biodegradation on the overall removal of contaminant mass is considered since it may seriously enhance efficacy of soil remediation. It should be recognized that data on microbial population size and the demonstration of DEHP degrading populations is useful as correlary evidence for microbial degradation of contaminants in test soil columns. However, direct verification of microbial degradation in the test columns, and quantification of its contribution to the overall mass balance was not conducted (or intended). (It is recognized that verification of microbial degradation and in test columns is extremely difficult undertaking.)
4.4.3.4	4-8	3	Initial Analytical Analyses. Please provide additional detail on the extraction process used on soil samples, including what solvents were used, what the intent of this extraction was and how these data were used to select four samples to be used on the soil flush treatability study (i.e., were the highest DEHP containing soils selected for further study?).

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4.5	4-10		Much of the material in this section, while appropriate, is relatively generic. Please assure that any case specific variances or modifications are discussed. For example, subsequent subsections discuss nonconformance identification and correction action measures which would be presumably taken. Please indicate whether any such nonconformance existed and what actions were, in fact, taken. Section 4.5.2 states that drawings were signed and dated by the draftsman performing the work and the project manager. Please indicate which drawings this statement applies to. Likewise, this section states that numerical analysis procedures were documented and then states that documentation may include several categories of calculations and programs. Please indicate where this documentation exists within the report. In summary, this section should be revised to represent what <u>was</u> conducted rather than what <u>would</u> be or <u>may</u> be conducted.
4.5.1	4-11	3	The text states that analytical methods are listed in Table 3. However, Table 3 presents data on volatile organics compounds in groundwater. Analytical methods do not appear to be provided.
5.1.1	5-1	1	Please provide discussion on how the groundwater composite sample presented in Table 4 was prepared and what groundwater sample was used to generate the data presented in Table 5.
5.1.2.4	5-2	2	Please discuss how the rate of which peroxide decomposes is related to is efficiency in transporting oxygen and how iron effects this oxygen movement. In the next to the last line on page 5-2, "plays" should be changed to "play."
5.1.2.5	5-3	2	The last word of this paragraph should be "redissolved" (past tense). The next paragraph in this section notes that nutrient amendment can be accomplished with no anticipated complications. Please indicate whether this applies to other nutrient sources then the proprietary mixture used in the study.

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5.1.2.6	5-3	2	As discussed in comments to Section 3, please indicate whether the recommended nutrient level takes into consideration the relatively high initial adsorption, the capture and recirculation of groundwater through the soils, and the potential for long-term release of nutrients from soils following initial application.
5.1.2.7	5-3	2	Please provide the basis for the hydrogen peroxide level used. In the subsequent paragraph under this section on page 5-4, please discuss how a dissolved oxygen concentration of 70 mg/l was achieved. In the following paragraph, please provide a relative definition of the phrase "moderate" hydrogen peroxide stability as compared to, for example, "high" or "low" stability.
5.1.2.8	5-4	1	Please describe "dilute" nutrient agar and how this differs from standard plate count agar concentration. Truly "dilute" agar would not solidify properly. Does this mean that the nutrients were more dilute than the standard formulation? Indicate why dilute agar was used if different from standard plate count agar. With respect to hydrocarbon degrading microorganisms, please indicate whether the carbon and energy sources were incorporated in the agar or present as a vapor phase above the agar.
5.1.2.9	5-4		This section addresses one of my previous comments on the use of the microbial stimulation tests.
5.2.2	5-3	2	Please discuss why removal data for ethylbenzene and xylene were not appropriate for regression analysis of rate constants and half lives.
5.2.4	5-7		The use of oxygen consumption data to verify the inhibition of biological activity is very useful.

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5.2.6	5-7	1	The statement is made that the abiotic control contained no bacteria. What is referred to here as the abiotic control is, in fact, the biologically inhibited control, and strictly speaking it would seem that the correct statement is that either this control contained no <u>added</u> bacteria, that it contained no detectable bacteria, or that this control exhibited no detectable biological activity based on oxygen consumption rate (as noted in Section 5.2.4). As previously stated in the test plan, the accuracy of the plate count technique is approximately 0.5 orders of magnitude leaving the possibility that viable bacteria may go undetected by this test. One of the most useful results come from the treatability study is the demonstration that indigenous microbial activity in site soils will support bioremediation without the need for additional supplementation.
5.2.7	5-8		Please indicate whether nutrient data represent total or soluble (i.e., filtered) samples.
5.3.2			The text states that soil samples were selected based upon an initial analysis of phthalate fairly concentration of selected samples. However, a later sentence states that this sample selection was based upon sample integrity, sample depth, and estimated concentration based upon site characterization data. Please clarify how the exact samples for soil column testing were, in fact selected.
5.3.3.1	5-9		The text states that geotechnical data for the selected soil cores are presented in Table 15. The analytical parameters presented in Table 15 do not entirely agree with those presented in Section 4.4.3.5. In particular, please indicate where particle size distribution data are presented in the report.
5.3.5	5-10		Please indicate why water samples were allowed to equilibrate to the atmosphere 24 hours prior to use.

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5.3.5.1	5-11	2	It should be recognized that the matrix of soil flushing solutions used in the various cells does not permit direct performance comparison since the soil source differs among the four cells.
5.3.5.2	5-11	1	Please indicate why gravimetric measurement of flow rather than volumetric measurement is used.
5.3.6.1	5-11	1	This discussion of data presentation in Tables 20 through 24 and the tables themselves are confusing. Referring, for example, to Table 20, please indicate that actual dates or time periods referred to as Period 1, Period 2, Period 3, and Period 4 under Phases 1 and 2. Furthermore, please indicate whether the "composite" represents a discrete sample from a different time period within these phases and indicate whether that "composite" volume includes the individual Period 1 and Period 2 sample volumes. This clarification is important in understanding the summation of contaminant removal as presented, for example, in Table 25. As presented in Table 25, it appears that the composite sample is discrete from the Period 1 and Period 2 samples. However, the text suggests that the composite sample includes the entire Phase 1 flushing period. This should be clarified. The need for this clarification is also evident in the following paragraph; the discussion of the rate of removal of VOCs from soils in the <u>first four days</u> of flushing vs. the <u>final three days</u> of flushing or the composite suggests that these time periods correspond to the three sample periods reported in Table 20. However, this is not clear from the text. Again in Section 5.3.6.2, the discussion refers to Day 4 leachate rather than Period 1 or Period 2. Overall, the various sample periods and the dates to which they apply should be clarified.
5.3.6.2	5-12	2	Please indicate how the selection of surfactant concentration was made and how this relates to potential field application.

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5.3.6.2	5-12	4	The text states that the study indicated a constant removal of DEHP. Is this intended to suggest a constant removal <u>rate</u> or a <u>continuing</u> removal through the study period?
5.3.6.2	5-12		The discussion of amendments of various cells in this section vs. the table on page 5-11 and the data presented in Tables 20 through 24 appear inconsistent. This section states that Cell 1 received Brij 30/35 while Cell 2 received Tween 85. However, subsequently in this same paragraph, a statement is made that Cell 2 received hydrogen peroxide and nutrient amended flushing solution. However, on page 5-11, Cell 2 is identified as having received an aqueous hydrogen peroxide solution. The discussion of potable water flushing on page 5-3 cites data from Cell 2. However, based upon page 5-11, Cell 2 received an aqueous hydrogen peroxide solution and Cell 3 received potable water. The subsequent discussion on page 5-13 of hydrogen peroxide and nutrient amendment solution refers to Cell 3, again contradicting data presented on page 5-11. The discussion of the effects of the various flushing solutions on contaminant removal cannot be evaluated until these discrepancies are clarified.
5.3.7.1	5-14	4	The comment that the comparison between initial final soil concentration is strictly relative based upon the soil sampling requirements is quite useful in evaluating the data. At the same time, this fact means that the relative change in concentration cannot be used as an assessment of the ability to meet specific cleanup criteria for the rate of which such treatment can be achieved.

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5.3.7.2	5-14 & 5-15	4	As presented in this section and in Table 29 (and as previously suggested in the discussion of the mass balance procedure), the percent reduction reported in Table 29 actually represents the distribution of recovered contaminant between the solid and liquid phases, respectively, and not the reduction as compared to initial soil contaminant loading. It cannot, for example, be concluded that 87% of initial DEHP loading will be removed by surfactant flushing because it cannot be definitively stated that the quantity recovered in the liquid and solid phases represents the initial mass present in the soils. If, for example, in situ bioremediation is occurring (as would be hoped), the total quantity recovered in the solid and liquid phases at the end of the study underestimates the initial mass present.

The following comments are editorial comments related to various data tables.

Table 1	Clarify that these are batch biodegradation study treatments not soil flushing treatments in the title and differentiate between biologically inhibited and abiotic controls. (Both phrases were used in the text.)
Table 3	Please indicate in a footnote the interpretation of data values presented in parentheses. Presumably, these represent the detection limits.
Table 9	It is recommended that either units of measurements be deleted from the heading (since the footnote explains the difference between the units for soils and groundwater) or that the appropriate units be cited separately for soils vs. groundwater.
Table 13	The assumptions and calculations used in estimating the oxygen balance should be presented. In particular, the basis for the expected oxygen consumption should be discussed. The theoretical oxygen demand of 5.3 milligrams of oxygen per milligram of organic carbon as stated on page 5-3 and as used in this table, should be discussed.

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	Table 25		If the Phase 2 composite sample represents a composite of samples from Periods 3 and 4, it is incorrect to sum the mass removals from these three samples to achieve final total removal. (The relates to the previous comment requesting clarification of Tables 20 through 24, and also applies generally to Tables 26 through 29.)